Implementation of a basal melt parameterization in MOM5

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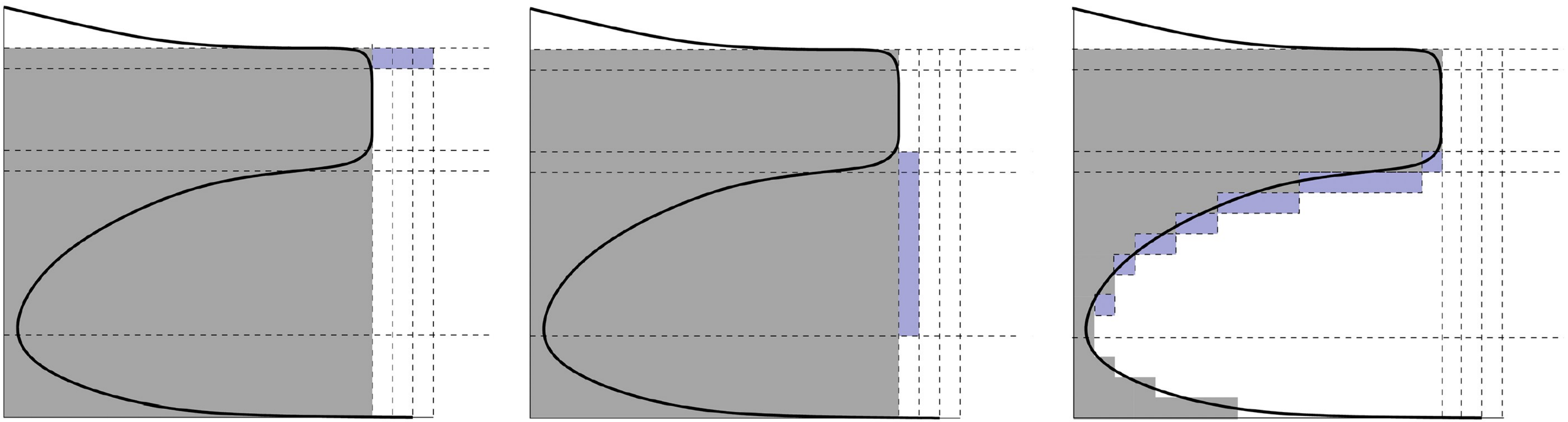
Context

a) Runoff at surface

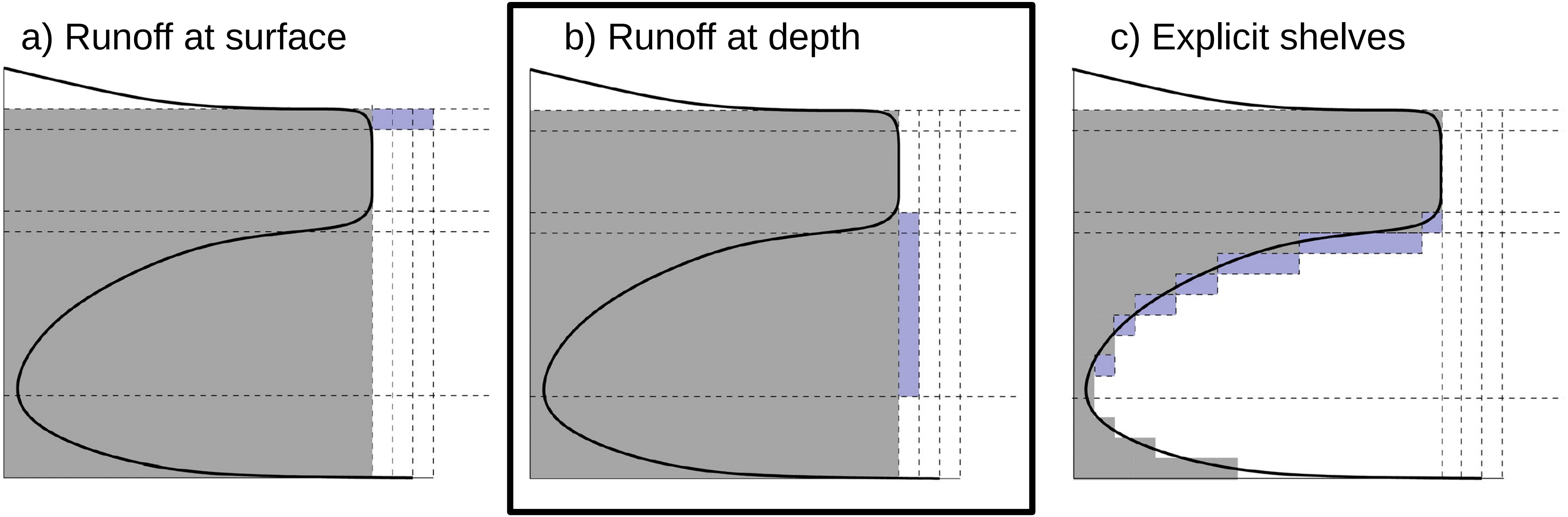
b) Runoff at depth

c) Explicit shelves



Mathiot et al., 2017

Context



$$T_R = \frac{T_{insitu}\rho\Delta z + T_{freez}q\Delta t}{\rho\Delta z + q\Delta t}$$

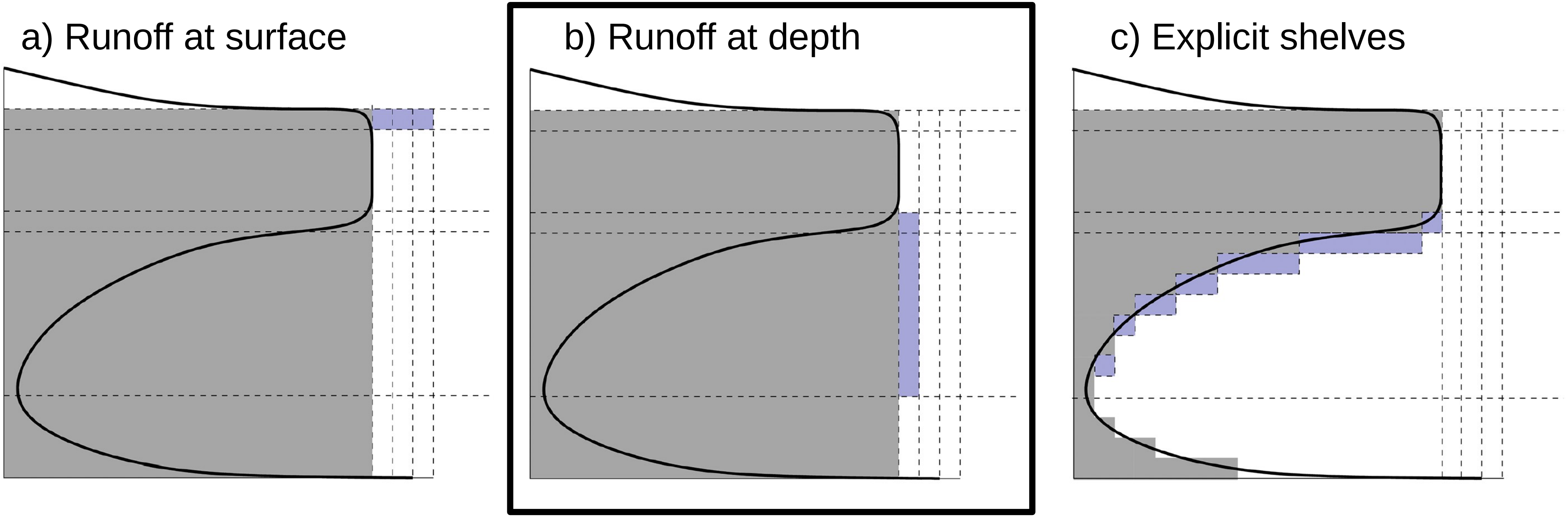
$$S_R = \frac{S_{insitu}\rho\Delta z + S_{freez}q\Delta t}{\rho\Delta z + q\Delta t}$$

Heat and Salt balance

Constant in time

Mathiot et al., 2017

Context



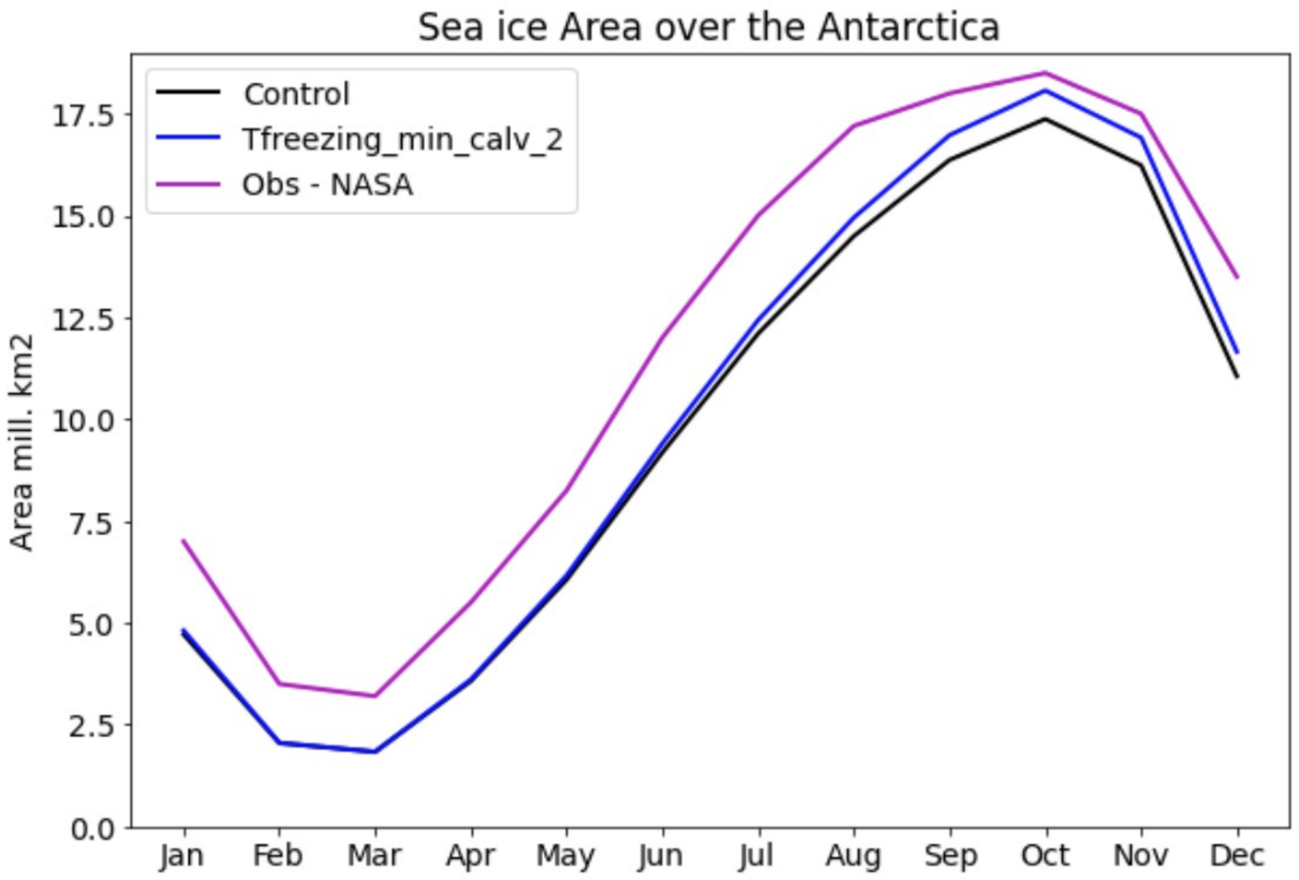
1/10° horizontal resolution

Run for 7 years

Restart after 250 years run

Mathiot et al., 2017

Sea-ice extent

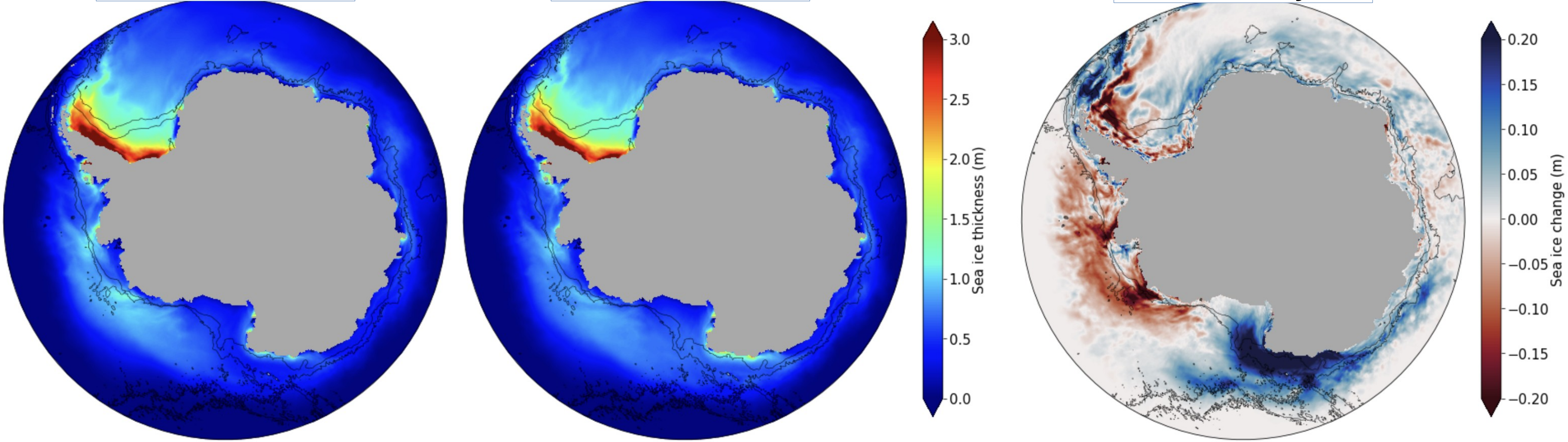


Already known bias described by Andrew Kiss in a presentation:
https://accessdev.nci.org.au/trac/raw-attachment/wiki/ThursProg/14.Andrew_Kiss_ACCESS_science_days_2021.pdf

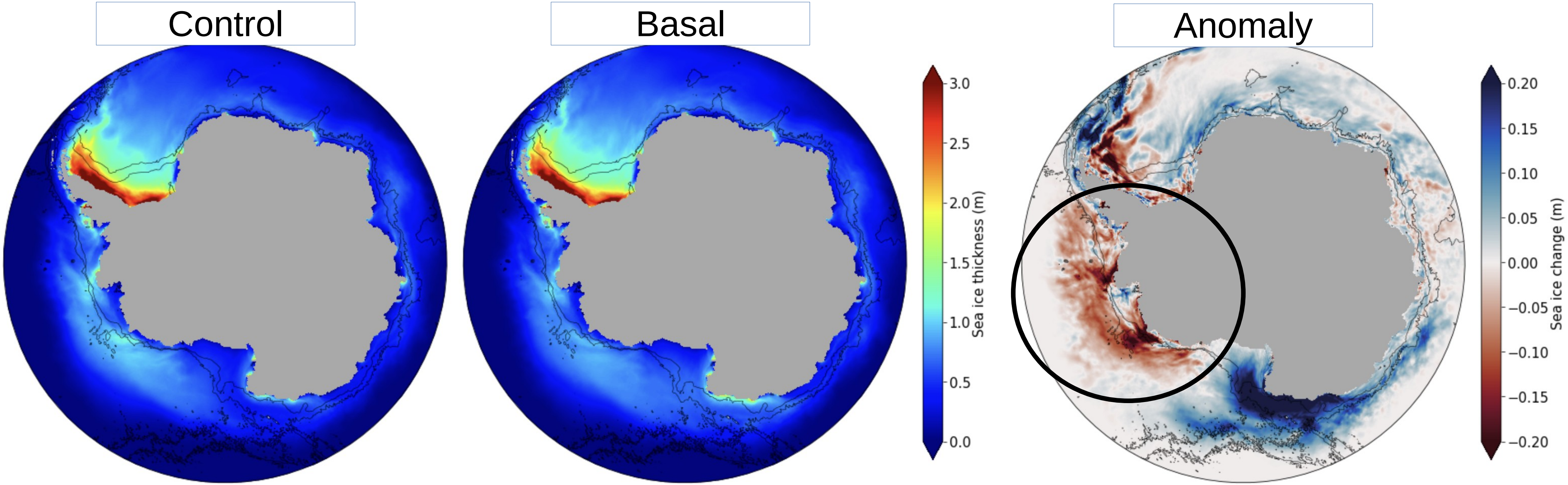
Obs: https://earthobservatory.nasa.gov/world-of-change/sea-ice-antarctic

Sea-ice thickness

Control Basal Anomaly

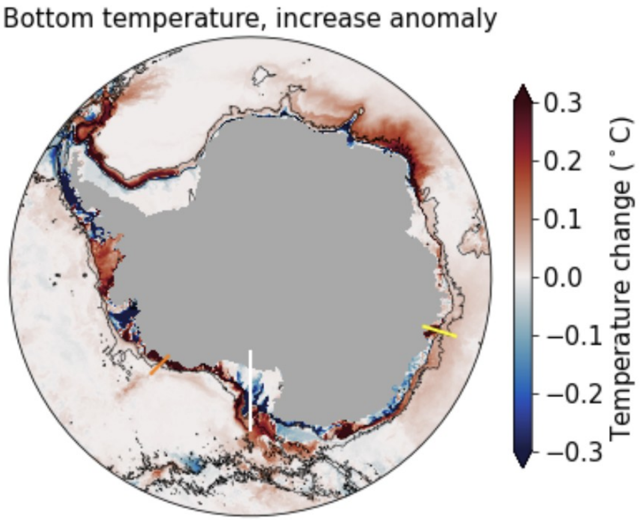


Sea-ice thickness



The reduction of the sea-ice thickness in the Amundsen sea can be explained by the entrainment of CDW (Jourdain et al., 2017)

Entrainment - Amundsen



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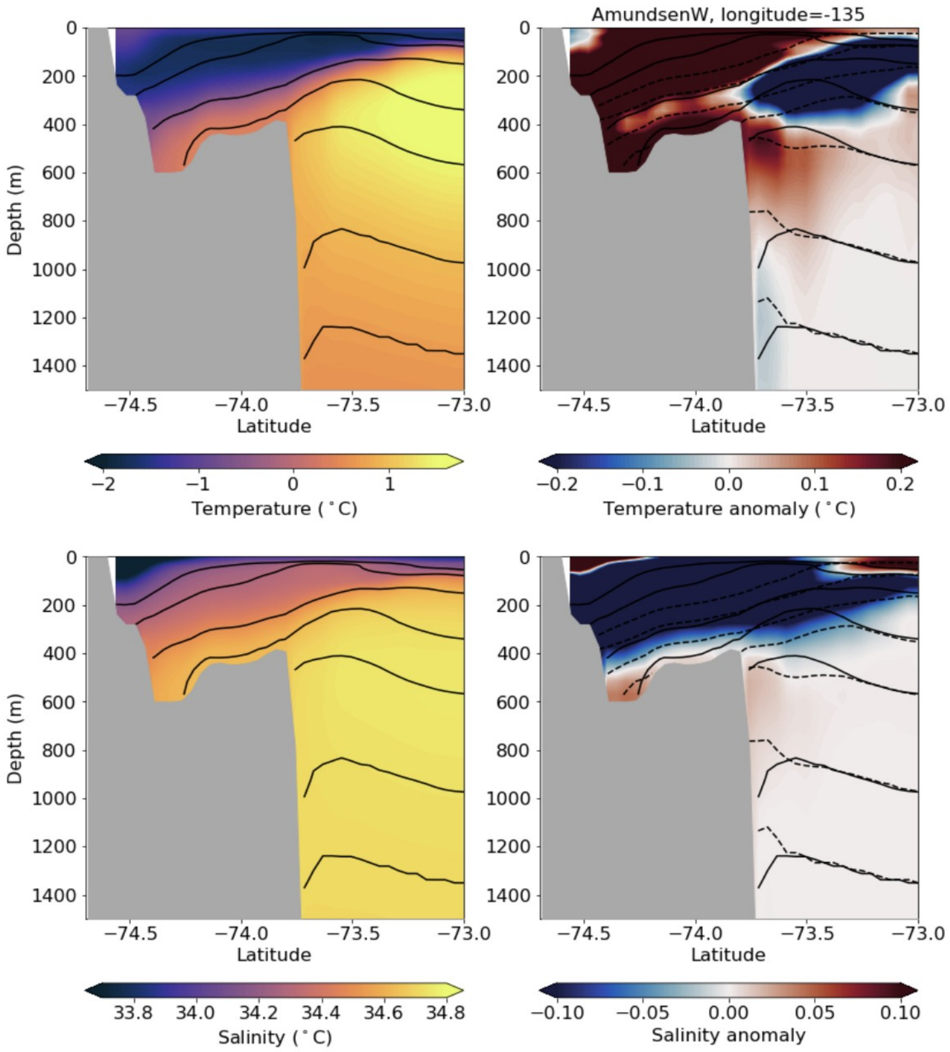
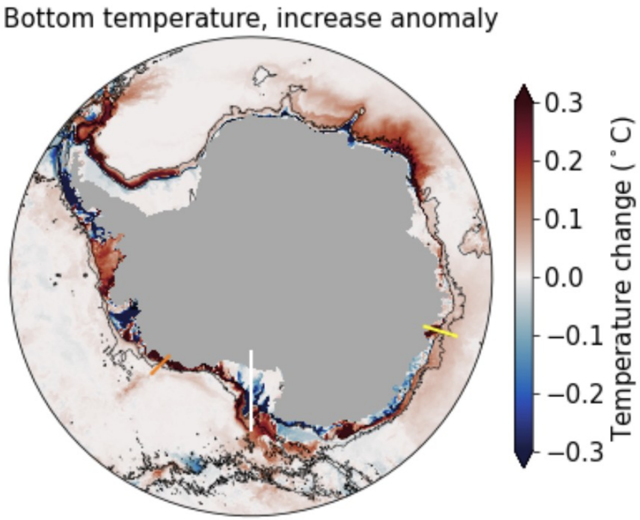
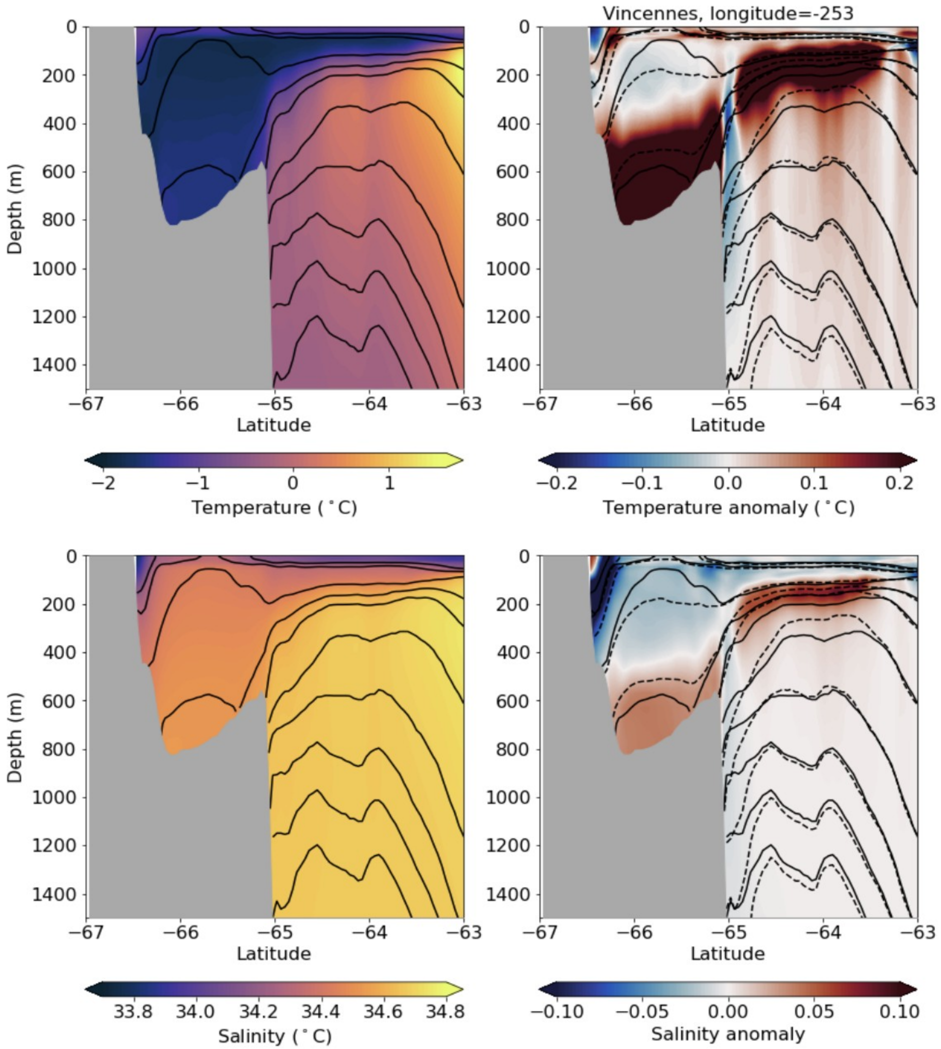


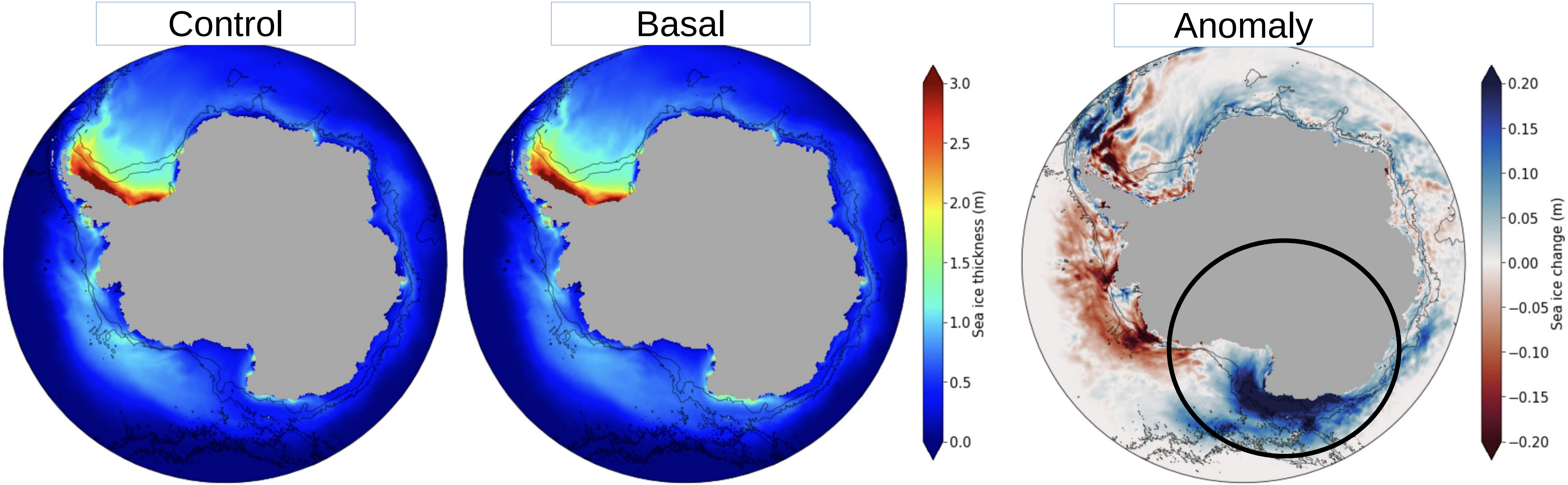
Entrainment - Vincennes





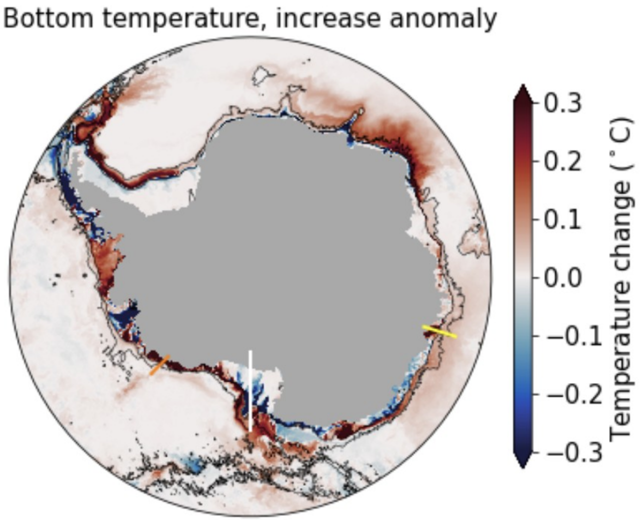
This is another example of
CDW entrainment

Sea-ice thickness

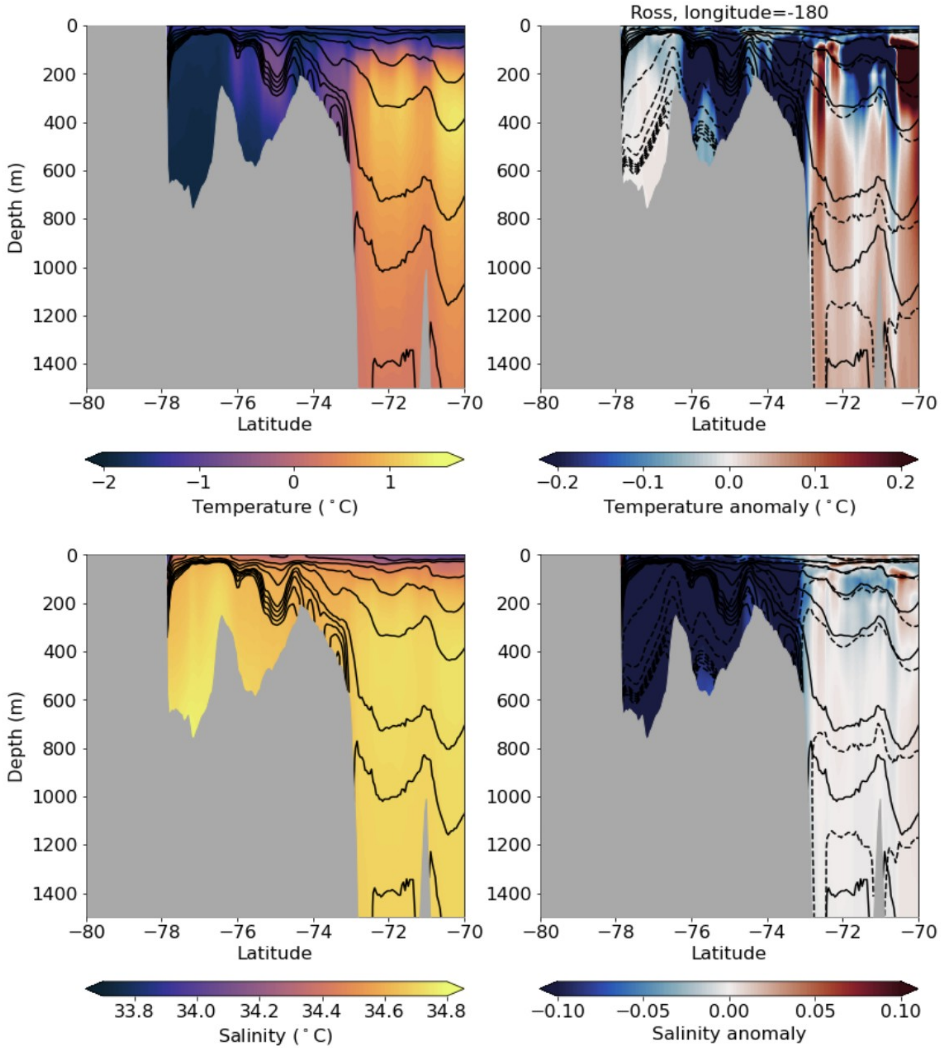


Ross sea export waters impact sea-ice thickness

Ross sea

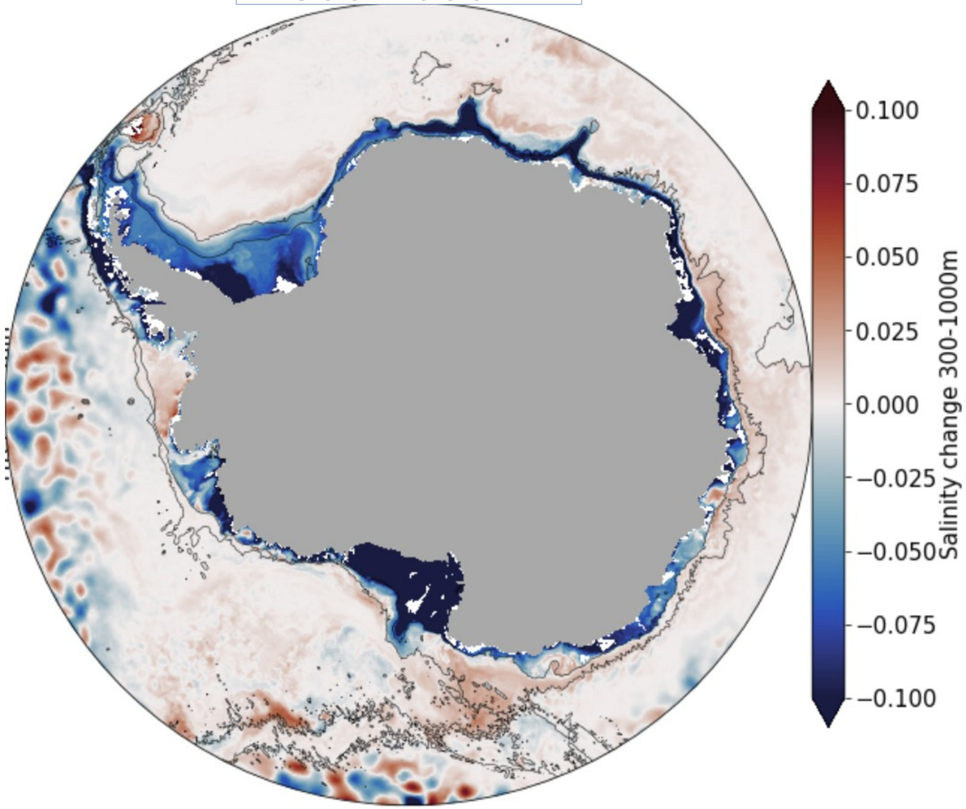


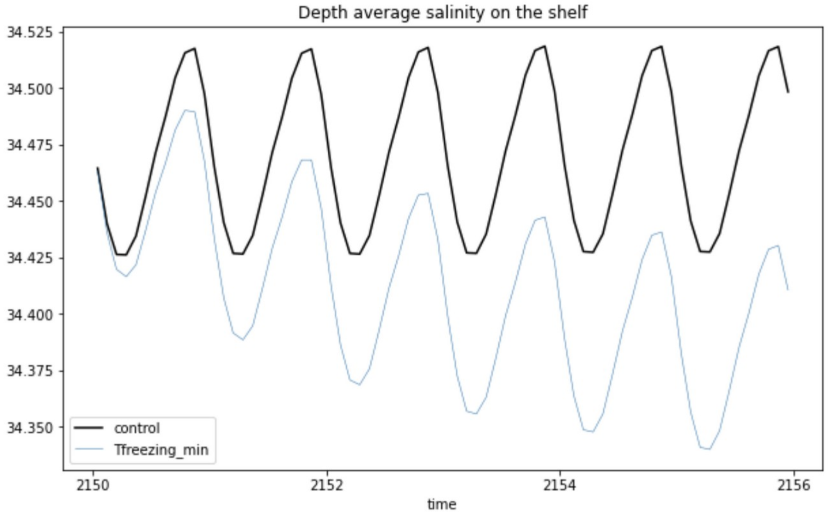
Cold Ross basal export water seems to block CDW



Shelf freshening

Salinity anom.
300-1000m





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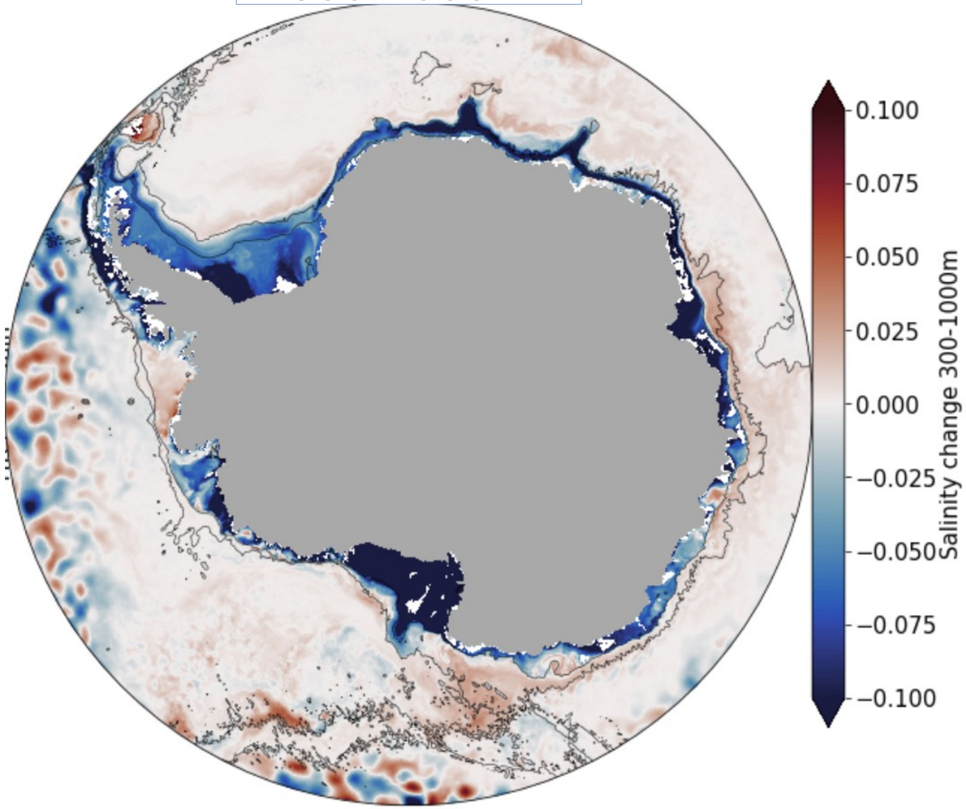
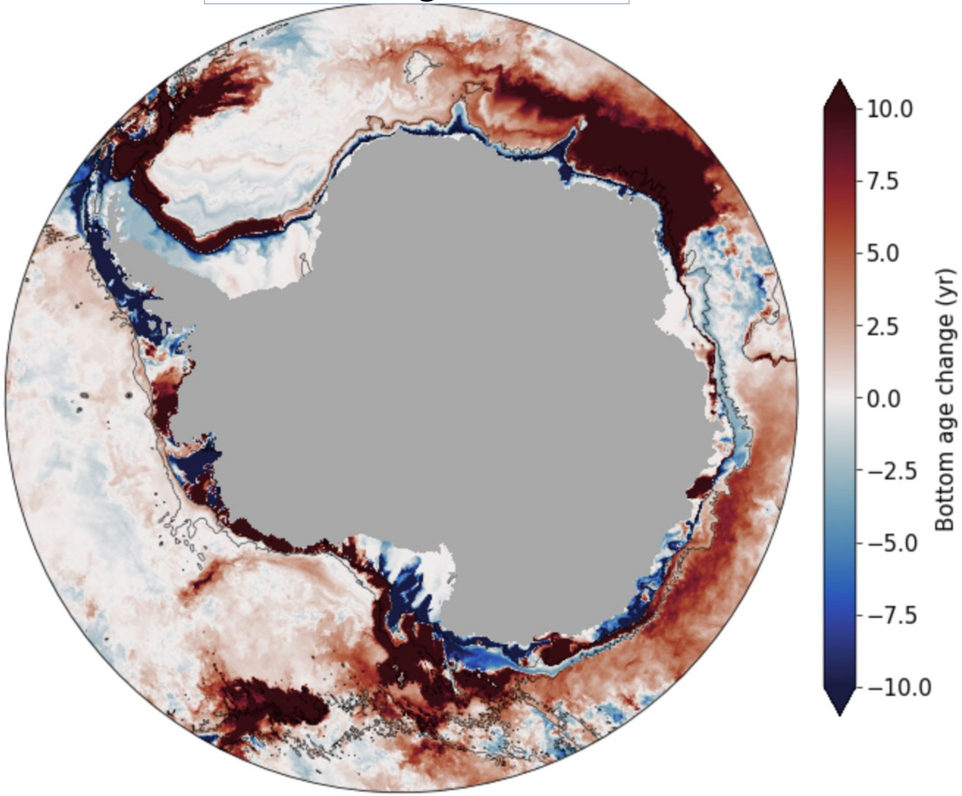


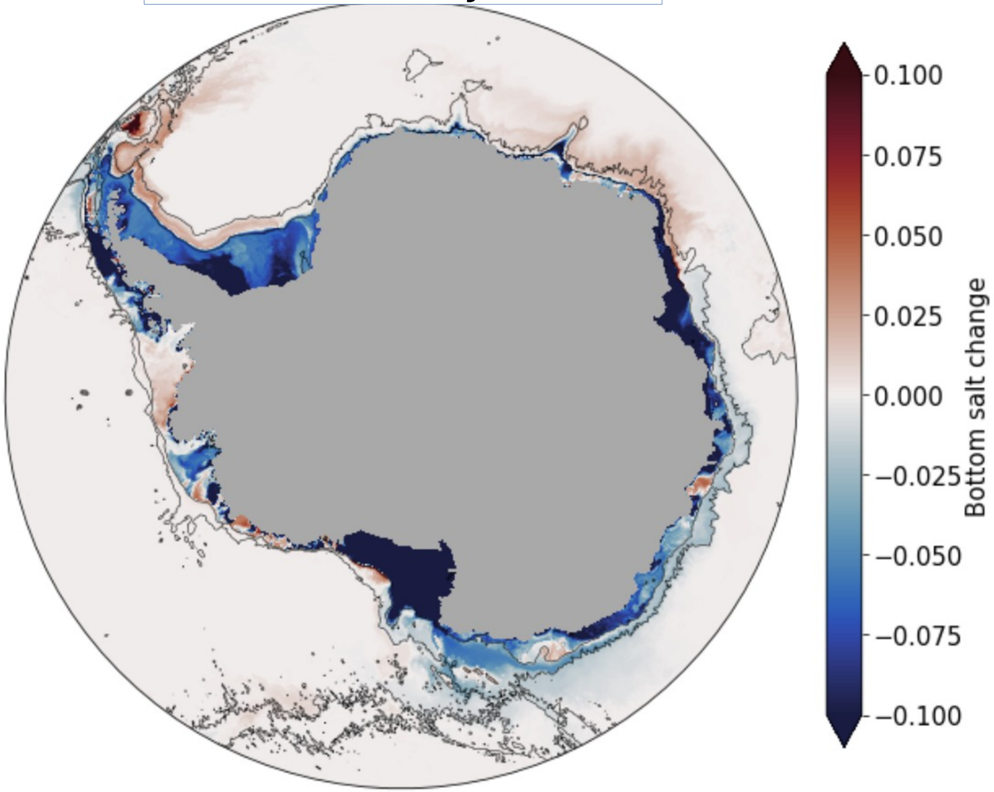
Bottom Age anom.



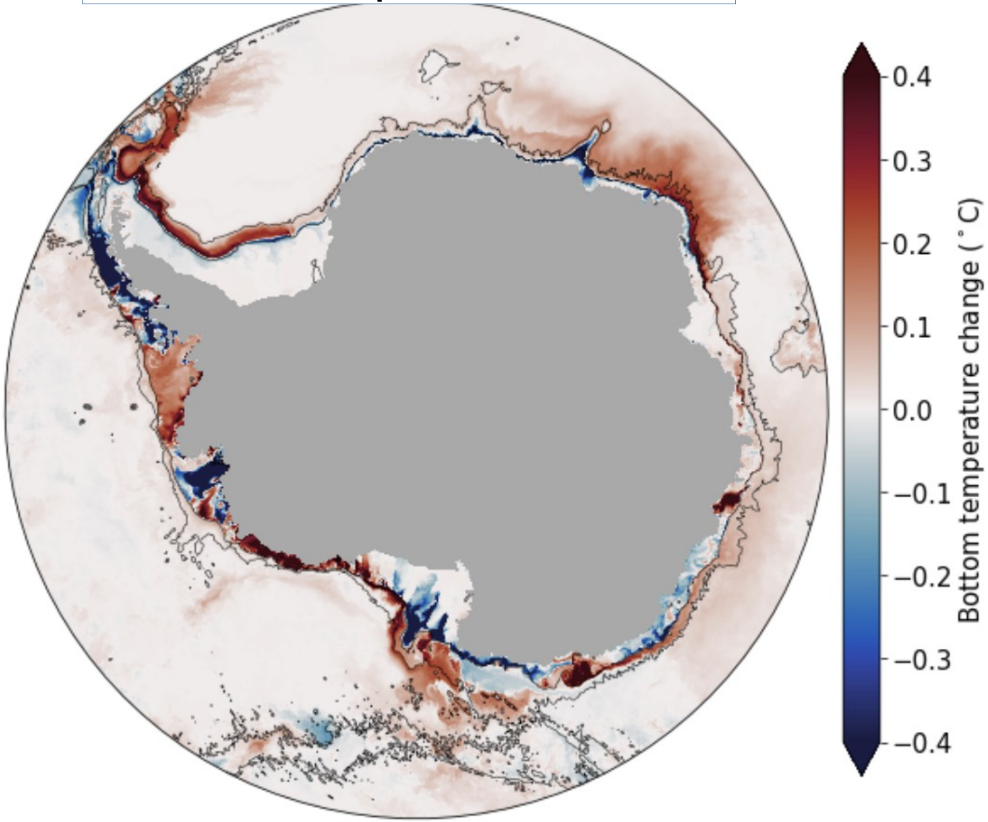
The age increases in overflowing areas

Shelf freshening

Bottom Salinity anom.



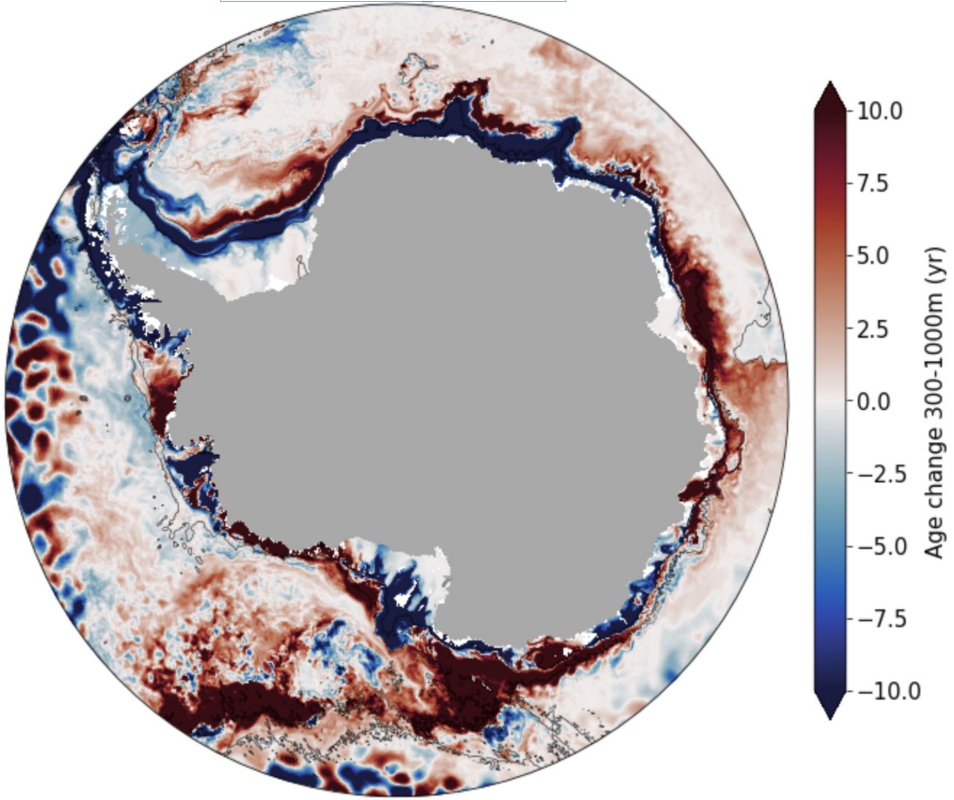
Bottom Temperature anom.



About 0.2°C warming in the main overflows

Impact on ASC

Age anom.
300-1000m

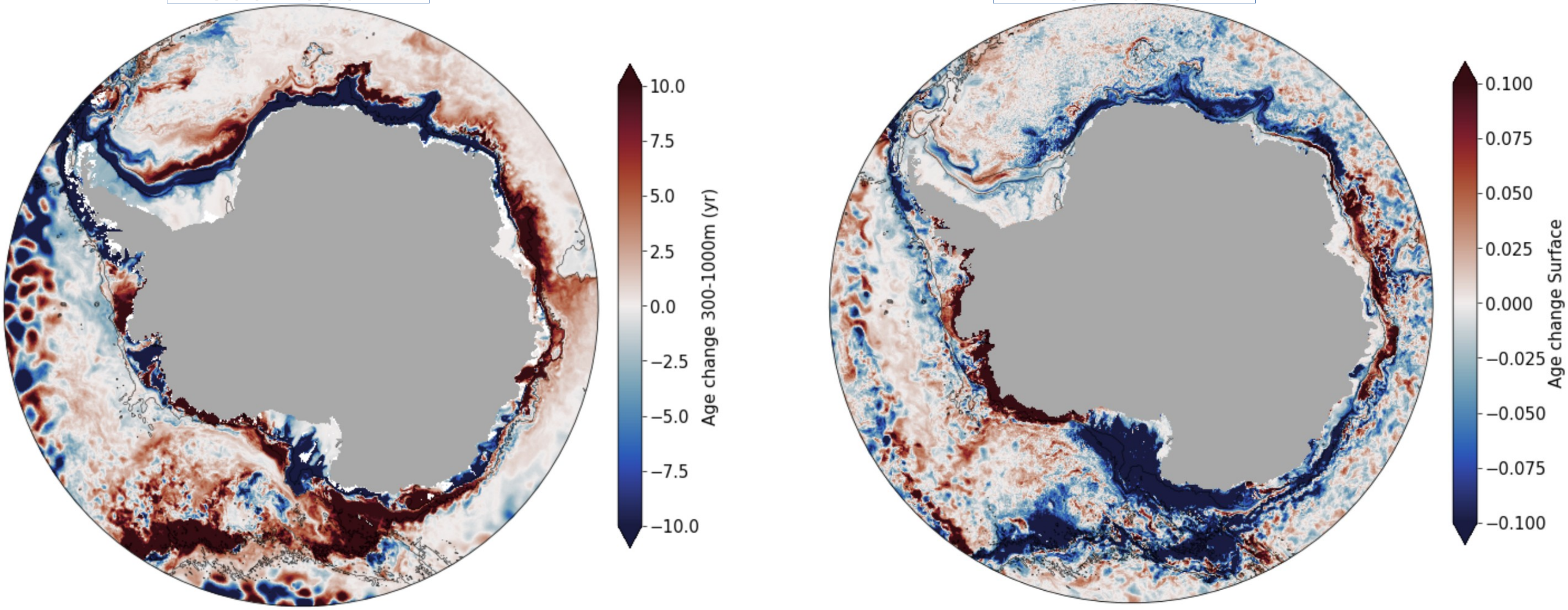


In only 7 years the circulation considerably changed specially in the ASC representation

Impact on ASC

Age anom. 300-1000m

Age anom. Surface



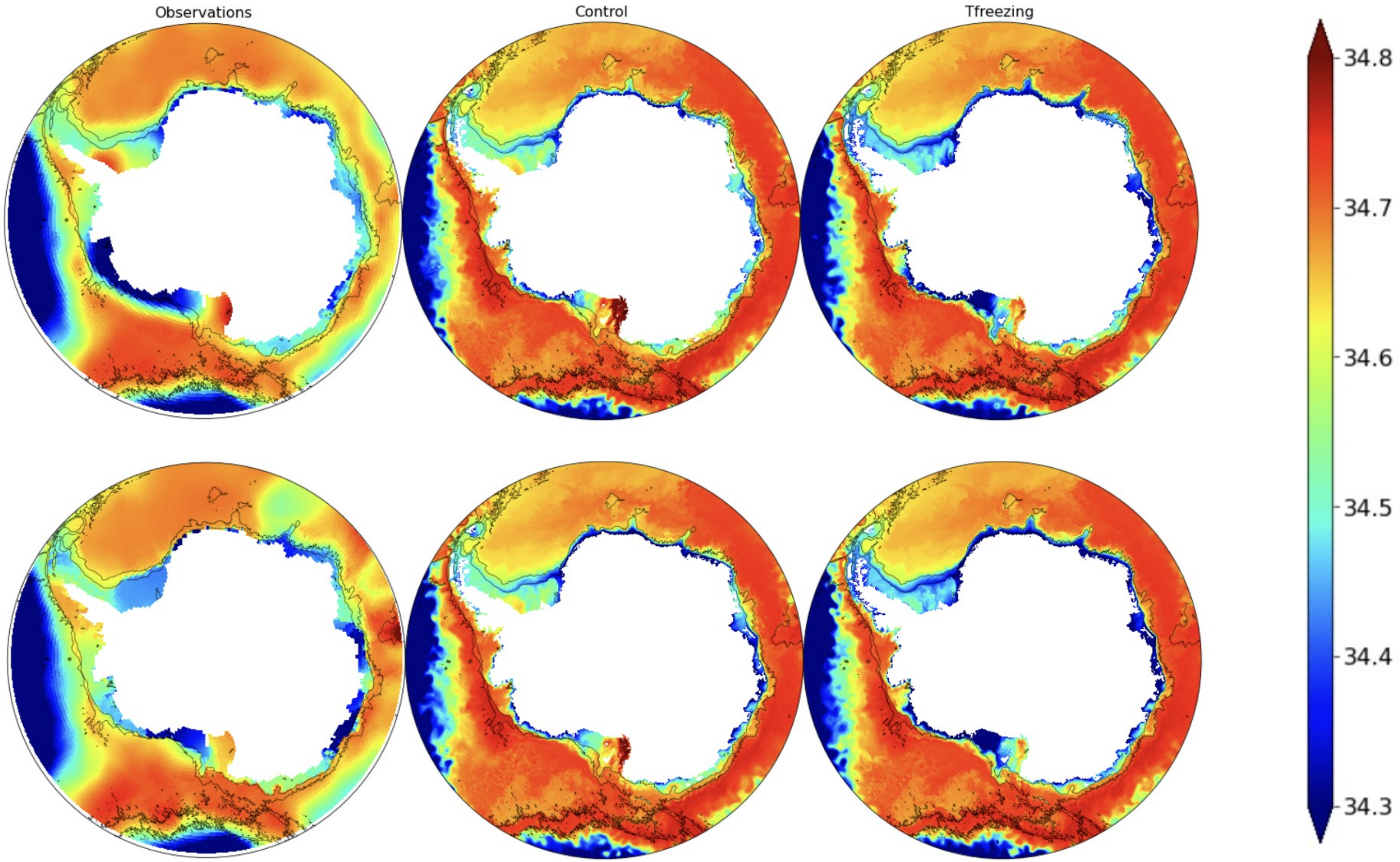
Surface age anomalies highlight regions of entrainment

Comparison with observations

Salinity
at 300m

January

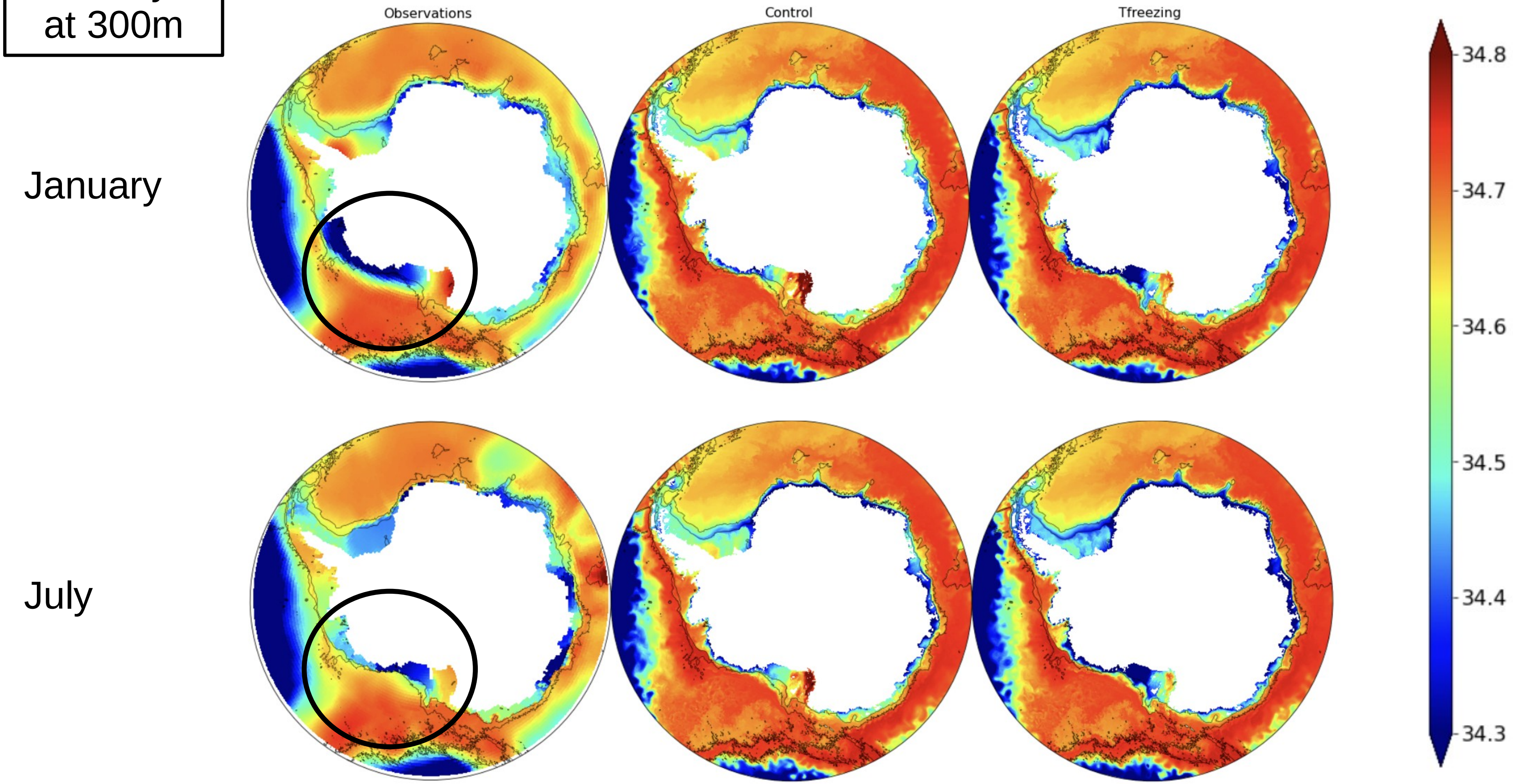
July



Schmidtko et al., 2014

Comparison with observations

Salinity at 300m

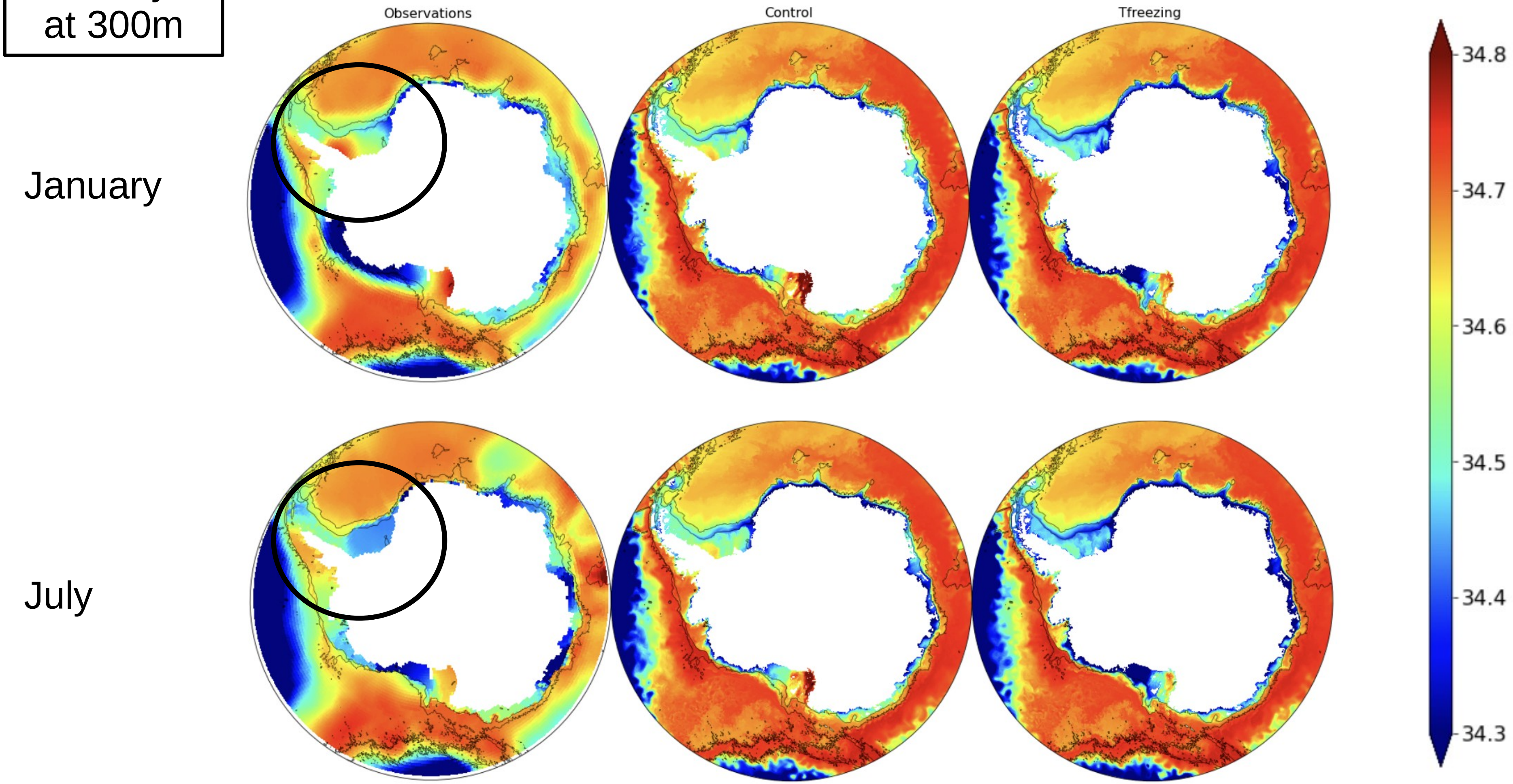


Seasonal cycle

Schmidtko et al., 2014

Comparison with observations

Salinity at 300m

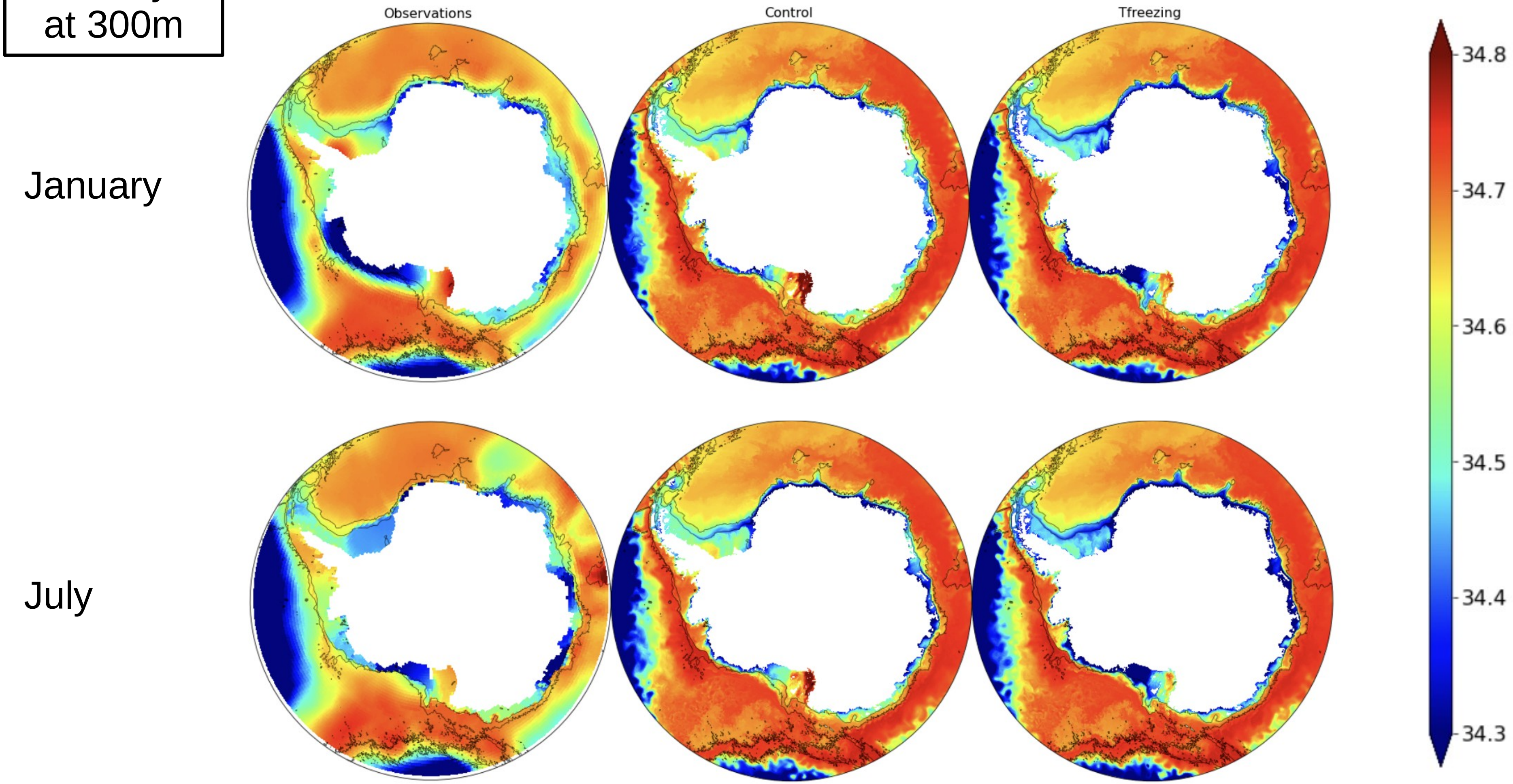


Seasonal cycle

Schmidtko et al., 2014

Comparison with observations

Salinity at 300m



Schmidtko et al., 2014

Conclusion and perspectives

Distributing the runoff at depth has shown positive aspects

- We were able to model the intrusion of CDW in areas where this is expected to happen
- The runoff at depth modifies the ASC as it is also expected
- Better comparison with observations
- Step forward in terms of model description

On the contrary

- The shelf freshening reduces the overall density and therefore the overflows end-up being warmer and saltier (we lose dense waters)

Perspectives

- Impact on the different properties (ice shelf thickness) with varying FW flux and wind anomalies
- Impact of basal melt on the CDW properties
- Gade line formulation implementation

Resulting temp formulation

Previous formulation (heat balance)

$$T_R = \frac{T_{insitu}\rho\Delta z + T_{freez}q\Delta t}{\rho\Delta z + q\Delta t}$$

Gade line

$$T_R = T_{insitu} - \frac{\Delta S}{S_{insitu}}\frac{L}{C_p}$$